

ECOFRIENDLY RAT MANAGEMENT TECHNOLOGIES IN THE PADDY FIELD



CENTRE FOR INDIAN KNOWLEDGE SYSTEMS

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Centre for Indian Knowledge Systems,
Chennai

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PREFACE

While agriculture still contributes to the major part of the national economy it has been under threat from a variety of directions. Pests and diseases at various stages of crop growth are estimated to destroy over 15% of the food grains. Among the storage pests of a non insect nature, rats cause significant damage and economic loss. This project was initiated in the Nagapatnam district of Tamilnadu by our Centre to evolve a package of ecofriendly technologies for management of rats in paddy fields. The project had a three pronged approach seeking to address the problem comprehensively and it consisted of the following components

1. Laboratory trials carried out in collaboration with the Agricultural College of Annamalai University.
2. Field trials with extensive participation of farmers and farmers groups.
3. The programme evolved in close collaboration with the Irula Tribal Community who are traditionally known for their skills in rodent control.

A strong aspect of the entire work was to see it in a larger framework with an intense campaign raising awareness regarding the larger environmental framework in which the problem got aggravated. There are many groups and individuals who have been involved in providing assistance and we are grateful for all the help and support (details are listed separately). We are thankful to the SEED division of the Science and Technology Division for supporting this project and publication.

Chennai
August 2012

A.V. Balasubramanian
Director

Centre for Indian Knowledge Systems : A Brief Profile

Objectives

The Centre for Indian Knowledge Systems is an organisation devoted to exploring and developing the contemporary relevance and applications of traditional Indian knowledge systems - with the focus areas being agriculture and health care. Our aim is to strengthen and revitalize indigenous sciences and practices.

Activities

Some of the major programmes of the centre are :

- Action Research and Training Programmes on various aspects of sustainable agriculture.
- Setting up of Rural Gene Banks for the conservation of Traditional Seed Varieties.
- Developing organic packages for crops such as paddy and cotton.
- Research on the applications of Vrکشayurveda (Traditional Indian Plant Science).
- Preparation of audiovisuals on various aspects of organic farming.
- Publication of books, posters and newsletters on Traditional Health Care and Traditional Agriculture.

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- Members of *Irular Aadavar Suyu Udhavi Kuzhu* (Irula Men's Self Help Group), Bhagavath Singh Nagar, Vaitheeswaran kovil, Nagapatnam district, Tamilnadu
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- Dr. S. Nagarajan, Assistant Professor, PG and Research, Department of Zoology, A.V.C.College, Mannampandhal, Mailaduthurai, Nagapatnam district, Tamilnadu for research and training programmes related to barn owl conservation
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Chapter - 1

INTRODUCTION

Agriculture is the backbone of India, contributing to the major part of the national economy. Therefore, a healthy agriculture sector would play a significant role in the prosperity of the nation. However, agriculture sector is on a decline, in terms of the number of individuals involved and its contribution to the GDP. The issues affecting this sector are high cost of cultivation due to high price of pesticides and fertilizers, loss in soil fertility, water scarcity, changing climatic conditions, labour scarcity, unavailability of electricity, low premium for the agriculture produce etc. Farmers are also not getting good quality seeds and inputs in required quantity on required time. Though, the government provides various schemes for the farmers, these do not reach the entire farming community, especially the small and marginal farmers for various operational reasons. Rural urbanisation and the demand of land for housing and industrialisation have also provided an avenue for farmers to give up their agricultural lands to take up other occupational activities.

One of the major problems that is facing agriculture today is a great degree of loss due to pests and diseases. Crops are being damaged by a large range of pests and pathogens and this is being compounded by the resistance developed to various chemical control measures. It is estimated that every year approximately 15% of the food grains are damaged during storage by pests. Among the storage pests, rats caused significant damage and economic loss.

This book deals with the management of rat menace through ecofriendly methods in the paddy fields.

Damage Caused by Rats

Crop damage caused by pests and diseases occur at various stages of crop growth as well as during storage. It is estimated that, every year approximately 15% of the food grains are damaged or destroyed during storage by pests. Among storage pests and non-insect pests, rats cause significant damage and economic loss. Farmers are spending a lot for the management of pests and diseases. Apart from these pests and diseases, rats play a major role in damaging crops and thus contributing to yield reduction. The damage caused by the rats are classified in to three types,

- The damage caused to the crops in the field at any growth stage.
- The substantial damage and loss they cause to the stored grains.
- The health hazards they cause to the humans, being carriers of many deadly diseases like *Leptospirosis* (Rat fever).

According to the agriculture experts Rs. 415 crores worth food grains per year are damaged by rats in the field as well as at storage level. At a global level, the economic loss due to the damage caused by the rats during storage is 33 million tonnes and at field level, it is about 20 million tonnes every year. Usually, at field level rats attack the fields at the stage of maturation of grains and collect the food grains and store it in their burrows. Approximate damage caused by rats is up to 25% loss at field as well as during storage. This results in heavy loss in the return of investments for the farmers. For example, in paddy fields the damage caused by the rats is very high and they attack

the crop at all stages from vegetative to fruiting stage and cause 5 – 10% loss in the total yield. Rats are well adapted to the agricultural habitats. Each rat consumes about 10 – 15 grams of food grains per day.

Impact of Chemical Rodenticides

In India, the menace of rodents are mainly tackled with the help of chemical pesticides / rodenticides. Though they are used for controlling the damage caused by rats, they always take a toll over other living beings of the ecosystem like beneficial insects, snakes, tortoise, birds, snails, small mammals etc. This results in a weak food chain and imbalanced ecosystem. Some of the common rodenticides used in India are,

- Barium carbonate
- Calcium cyanate powder
- Domorin
- Promodyon
- Strichnin hydrochloride
- Warfarin
- Zinc phosphate

The rodenticides are usually applied in the field after mixing it with some food grains. These chemical rodenticides also get mixed with soil and get into the water bodies during rains. This affects and pollutes the environment. The mortality of other living species due to rodenticidal poison leads to the destruction of the integrity of the ecosystem, broken food chains and results in imbalanced ecosystem. These chemicals also affect livestock and other domesticated animals. The residues of

the rodenticides get leached into the soil and water, which are absorbed by plants and passed on to humans when they consume such contaminated food products or water. Chemical rodenticides are not a preferable option for effective control of rats during grain storage since there are possibilities of its contamination with the food grains. Chemical rodenticides are toxic to humans.

Chapter - 2

PROGRAMME FOR ECOFRIENDLY MANAGEMENT OF RATS IN PADDY FIELDS

Introduction

Farmers use chemical pesticides like Aluminium phosphide, Zinc phosphide, Calcium cyanide etc., to manage rat menace in the cultivation fields and in storage godowns. These chemical pesticides used for rat control, also kills many beneficial insects, snakes, owls etc. These are the predators that, under normal conditions, would have kept the rat population under control. These chemicals, when not disposed off properly, pollute the environment, thereby affecting the rhythm of the eco system and destroying the food chain and makes the eco system totally imbalanced. The ill-effects of chemical control are now becoming increasingly evident and farmers are exploring effective control measures to control this rat menace without the side effects of the chemical rodenticides.

Rat Management in Sirkazhi

Centre for Indian Knowledge Systems (CIKS), has been working in Sirkazhi taluk of Nagapattinam district since 2001, promoting the cultivation and conservation of traditional paddy varieties through eco-friendly and organic farming methods. One of the issues identified by the farmers was the yield loss due to the menace caused by rats.

To have a better understanding and quantum of economic loss caused by rats in paddy cultivation, a survey was conducted in 2007. The study showed that, the loss of food grains ranged from 180 – 900 kg per acre (in monetary terms it is Rs. 400 – 4500/acre). Hence, the farmers were forced to adopt chemical control measures such as poison baits (rodenticides like aluminium phosphide, zinc phosphide, warfarin, calcium cyanide etc). The amount spent for the management of rat menace accounted for 15 – 20 % of the total cultivation cost by the farmers. Though the chemical poison baits has managed the rat problem up to 90% it caused serious problems to the environment, which include the reduction in the natural enemies seen in paddy fields such as frogs, snails, snakes, barn owls, wild cats etc.

Estimation of Yield Loss through Rat Control Activity

Rat control activity through the help of Irula expertise was taken up in Pagasalai, Kondal and Nemmelli villages of Sirkazhi taluk. The Irulas used the ecofriendly smoke pot method to catch the rats and ratlings in these villages. A total of, 4,149 rats were caught from these villages. Based on the number of rats and ratlings the rate of damage was calculated. The yield loss was estimated based on the quantity of paddy grains collected from the burrows of the rats and number of rats caught.

Total number of rats caught	4,149
Approximate paddy grain consumption/day/rat	15 g
Per day paddy grain consumption of 4,149 rats	62.235 kg
Per month paddy grain consumption	1,867.05 kg

As a result of rat control activity per day 62.235 kg of paddy grains were conserved from the damage. Hence, 1,867.05 kg paddy grains worth Rs. 21,471.075 were conserved per month.

Estimation of Grain Loss due to Rat Damage

Sl. No.	Name of the village	No. of rats	Daily paddy loss due to rats	Monthly loss due to rats	Paddy rate / kg	Total amount (Rs.)
1.	Pagasalai	876	13,140	394.20	11.50	4,533.300
2.	Kondal	1,612	24,180	725.40	11.50	8,342.100
3.	Nemmeli	1,661	24,915	747.45	11.50	85,95.675
Total		4,149	62,235	1,867.05	11.50	21,471.075

The results of the survey were shared with the farmers and during the discussions farmers were asked to list out the various traditional non chemical methods of controlling rats (Annexure-1). The methods listed by the farmers included, attracting barn owl through erection of perches, fumigation of rat burrows using paddy straw, use of Thanjavur rat trap, use of corn flour and cement bait, rat control using dead rats among other methods. Each of these methods were discussed and ranked by the farmers. The following methods were found to be most favourable among the farmers.

- Use of Irula tribal's expertise
- Thanjavur trap
- Conservation of barn owl species

As a follow up of this exercise, CIKS initiated a pilot study with the services of Irula Snake Catcher's Industrial

Cooperative Society located in Kancheepuram district to catch rats through traditional methods in 2008 at Thennankudi village. Irula tribals are traditional rat and snake catchers who were employed by the farmers, but the practice was discontinued when the farmers had started adopting modern system of cultivation (Annexure 2). The methodology adopted by the Irulas, is to fumigate the burrows through a pot filled with straw. The results were encouraging as by the end of the third day, 247 rodents were caught from an area of 15 acres.

To identify, validate and demonstrate non-chemical rat control measures involving biological, environmental and cultural methods, the Centre for Indian Knowledge Systems initiated a project on “Ecofriendly Rat Management Practices” with the help of the Department of Science and Technology of the Government of India. This programme was implemented in Aadhamangalam, Agani, Allivilagam, Ilayamadhukoodam, Ilayankudi, Kondal, Kottaimedu, Nemelli, Pagasalai and Valluvakudi villages of Sirkazhi taluk of Nagapattinam district.

As a first step of this programme, a detailed survey on rat damage was done in the selected beneficiary villages of Sirkazhi taluk to get to know the prevailing scenario. This survey covered 96 farmers from nine villages. This survey was conducted in two seasons *Kuruvai* 2011 and *Samba* 2012. Details like damage caused by rodents, rat management methods implemented, cost spent for the same and predator population existing in the village were documented. Based on the collected data the average damage rate was calculated (Table-1).

Table 1 :
Consolidated Details on the Survey on Rat Damage in Project Village in
Sirkazhi Taluk

Name of the Village	No. of responders	Crop days at which rat cause damage (Paddy)	Yield loss during <i>Kiruvai</i> season 2010 (per acre)			Yield loss during <i>Samba</i> (per acre)			Trap method (Rs)	Pot Smoking method (Rs)	Puffed paddy method (Rs)	Roban cake (Rs)	Average
			Minimum (kg)	Maximum (kg)	Average (kg)	Min (kg)	Max (kg)	Average (kg)					
Allivilagam	11	70 – 80	Nil	240	60	Nil	60	360	550	-	-	110	165
Ilaiyamadu koodam	10	60 – 75	Nil	90	46.5	Nil	150	150	475	275	200	90	260
Ilaiyankudi	12	60 – 90	50	240	84	30	120	47.4	238	238	20	-	124
Kondal	10	60 – 70	30	300	105	30	180	30	400	200	100	-	175
Matherivelur	10	60 – 90	180	1800	630	180	420	132	1200	1200	100	-	625
Nemmeli	11	45 – 60	120	300	147	120	240	40	200	250	50	-	125
Olaiyamputhur	10	65 – 70	150	366	147.6	60	300	103.2	300	200	50	-	137.5
Pagasalai	10	120 – 140	30	120	54	30	60	30	190	-	25	-	53.75
Valluvakudi	12	70 – 85	120	600	180	120	360	30	500	500	100	-	275

Chapter - 3

EXPERIMENTS CONDUCTED ON ECOFRIENDLY RAT MANAGEMENT PRACTICES

The Centre for Indian knowledge Systems collected data from various sources including personal interviews with farmers to find out suitable ecofriendly rat management methods. Based on the collected data few promising methods were experimented in the fields. Many mechanical rat management techniques were also tested at the field level. Five major experiments were conducted in the *Samba* season 2011. They are as follows.

1. Erecting “T” shaped stands in the fields for rat management
 2. Using three types of traditional traps for rat management
 3. Rat management following Vrکشayurveda method
 4. Plant bark extract as rodenticide
 5. Other eco friendly rat management practices identified and implemented
- 1. Erecting “T” shaped stands in the fields for rat management**

Barn owls (*Tyto alba stertens*) are one of the major predators of rats in the fields. However, they find it difficult to locate the rats in the field for want of a vantage perching place within the cultivated area. Erecting “T” shaped wooden stands in the fields, provides perches for barn owls thereby facilitating them to wait within the fields and make it easier to catch rats in the target fields.

A wooden pole of nine feet long and one more of two feet long is assembled to form a T-shaped setup. These stands are placed in the field with a spacing of about 10-15 meter. These stands will invite owls as it will be helpful for them to sit and watch for its prey. The dropping left by these owls while they visit these stands will be a proof for its usage. This method is very cost effective.

2. Using three types of traditional traps for rat management

A comparative study of three types of traditional traps was conducted in Agani village in Sirkazhi taluk. These traditional traps are being used by the farmers of Sirkazhi taluk in different villages. The technology, mechanism and efficiency of these traps were also tested separately. The three traps used for the comparative study were:

- i. Thanjavur trap
- ii. Modified Thanjavur trap
- iii. Bow trap

i. Thanjavur trap

Thanjavur traps are commonly used by the farmers of Tamil Nadu for the management of rats. These traps made of bamboo sticks are very efficient in controlling rats in the fields. About 40 – 60 traps are used per acre. This is a traditional trap made of bamboo sticks and baits are kept at one corner of the trap. These are physical traps where rats are attracted to a thrust setup with a delicate balance using some rat feeds placed on either side of the balance stick. As the rat feeds on one side and passes through the trap to reach the feed on the other side, it displaces the stick causing a deadlock.

The height of the trap is 2 ft. They are usually set up in the field during evening hours and next day monitoring is done for the number of catches. 50-60 traps are used in an acre, depending upon the estimated damage/rat population. This has been adopted traditionally by the farmers for management of rats. Total area adopted for the testing was 5 acres and totally 100 traps were fixed daily for catching rats. A total of 90 rats were caught in the traps.

ii. Modified Thanjavur trap

Modified Thanjavur trap was developed by CIKS after making some changes in the basic model of the Thanjavur trap. Normally Thanjavur traps are shorter in height without any specific part for keeping the baits. Based on a discussion with trap fixing people from three villages viz. Agani, Nemmeli and Kondal some modifications were made in the traps, such as,

- a. A small sized plate for placing the feed was fixed in the trap. Sometimes bait kept in the traps fall into water and rat cannot be caught in the trap. To avoid this situation and to have 100 % catches, the plate was fixed to the trap.
- b. The height of the trap was increased to 1.5 ft (total height 3.5 ft)

In the modified trap, the height was increased and a small bowl for baits was fixed. The modified traps can be easily identified in the fields that stand above the crop level. The time for keeping baits in the trap is also reduced considerably and the remaining bait is not spoil. Cost of fabricating each of these traps was Rs. 42.50 and the individuals involved in the fabrication of these traps were:

- Mr. P. Rajendran (fabricated the trap), Valluvakudi Main Road, Valluvakudi (Post), Sirkazhi Taluk, Nagapattinam District. Mobile : 9976083795.
- Mr. G. Sampath (fabricated the trap), Nainarthope, Vaitheeshwaran Kovil (Post), Sirkazhi Taluk, Nagapattinam District. Mobile : 9003562774.
- Mr. G. Sampanthamoorthy (fabricated the food bowl), old iron shop, Thermelaveedhi, Sirkazhi taluk, Nagapattinam district.

The feed back received from the farmers on the modified traps were:

- Modified Thanjavur traps are easy to handle.
- The time required for installing the traps in the field is very less when compared with the actual Thanjavur trap.
- Since there is a separate bowl for baits, the remaining baits would not be spoiled by getting mixed with mud.
- These traps with increased heights can easily be identified in the field for regular checking.

iii. Bow trap

Bow traps are not commonly used by the farmers of Tamil Nadu, as their working mechanism and fabrication is complex. In Ilayankudi village of Sirkazhi taluk bow traps are being used by many farmers. Since the shape of the trap is like a bow it is called as bow trap. The height of the trap is 4 ft. and can be easily identified in the field. Rats and snakes in the fields cannot escape easily, as the force of the trap is high and stuns/kills the animal when it gets trapped. 40 – 70 traps are placed in an acre.

These traps cannot be fixed by farmers, as it needs an experienced hand. 200 bow traps were distributed to selected farmers for experimental purpose. These were kept in the paddy fields at Ilayankudi village @ 50 traps per acre and were monitored.

The feed back from the farmers were

- Due to the very complex mechanism of the bow traps, many farmers do not use them.
- The force of the trap is very fast that would not miss any rats, snake etc., that touches the trap.
- Fixing of traps in the fields takes more time and handling of the trap is very difficult.

Comparative Study of Traps

A comparative study of Thanjavur trap, modified Thanjavur trap and bow trap was conducted in the paddy fields of White Ponni paddy variety in Thennangudi village of Agani Panchayat to find out the efficiency of these traps. The selected field was divided into three parts and different traps were fixed in these three parts. The rat catching capacity of the traps were studied for six days and based on the number of catches the efficiency of the trap was evaluated (Table - 2). The general comparison of these traps are given in Table - 3.



Table 2 :
Number of Rats Caught using different Traps

S. No	Date	No. of Rats Caught in the Trap		
		Existing Thanjavur Trap	Modified Thanjavur Trap	Bow Trap
1	4.12.2011	3	4	3
2	5.12.2011	5	4	3
3	6.12.2011	5	4	1
4	8.12.2011	1	2	1
5	10.12.2011	2	3	3
6	11.12.2011	2	3	-
Total rats caught		18	20	11

Table 3 : General Comparison of Traps

Sl. No.	Particulars	Thanjavur traps	Modified Thanjavur traps	Bow trap
1.	Cost of fixing the traps (per Acre)	Rs.1,400 (includes labour charge)	Rs.2,300/- (includes labour charge)	Rs.1,650/- (includes labour charge)
2.	Cost per trap	Rs. 25	Rs. 45	Rs. 30
3.	Efficiency a. No of Catches b. Time factor	25-30 rats/50 traps 1 hour / acre	30-35 rats/50 traps 30 min/ acre	25-30 rats/50 traps 1hr 15 min/ acre
4.	Benefits	Semi skilled labour is essential	Farmer can fix in the field	Skilled labour is essential

3. Rat management following *Vrkshayurveda* method

According to Surapala's *Vrkshayurveda*, burying a banana leaf with the scripts of a specific Vedic *mantra* will keep rats out of the field. The Vedic *mantra* specified for the rat control in *Vrkshayurveda* was written on a banana leaf using "Arakku" as its ink. Then the *mantra* was read once and the leaf is cut into a triangular shape with the scripts within it. This leaf cutting was finally buried in the middle of the field. But there is no significant control of rats in the field.

4. Plant extracts as rodenticides

Three plant species such as *Gliricidia sepium*, *Glyceria grandis* and *Ipomea carnea* which are mentioned as effective rodenticides in the literature were validated under the laboratory condition. This experiment was conducted in collaboration with the Department of Entomology, Annamalai University (Annexure-3).

Gliricidia bark extract, *Glyceria grandis* whole plant extract and *Ipomea carnea* leaf extract were prepared by soaking 50 g, 100 g, 150 g, 200 g and 250 g of bark / whole plant / leaf paste in 1000 ml of distilled water separately for 3 days and obtained 5.0, 10.0, 15.0, 20.0, and 25.0 percent concentrations respectively. 500 g of cooked maize seeds were soaked in various concentrations of these extracts separately for 12 hours and then shade dried. This bait was fed to female Albino rats (*Rattus norvegicus*) in acute oral toxicity study and in sub-chronic oral toxicity study treatments.

The results of the study are summed up below,

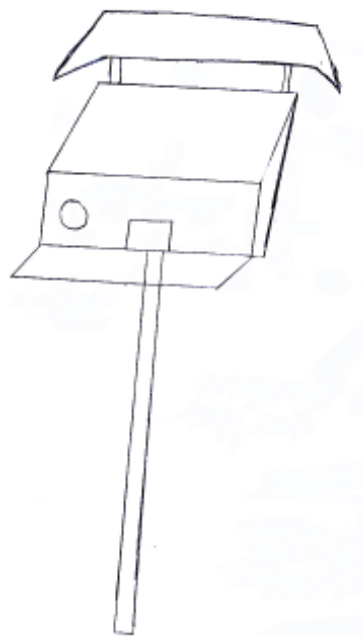
- In acute oral toxicity study, the water extracts of *Gliricidia sepium*, *Glyceria grandis* and *Ipomea carnea* @ 25% concentration did not record mortality. So, the test was concluded after 14 days of observation.
- In sub-chronic oral toxicity study, *Gliricidia sepium* @ 25% concentration showed significant changes in locomotory activity and breathing of the treated animal. The colour of the skin was also dull and change in fur was noted.
- Histological observation of the heart, liver and kidney tissue showed notable changes in *Gliricidia sepium* extracts (25 % concentration) treated rats.

5. Other eco friendly rat management practices identified and implemented

Barn owl and snakes are the two natural predators of rats. Awareness on these were created among the farming community and the activities carried out are detailed below.

Installation of barn owl boxes

Barn owls are one the major predators of rodents. In nature, owls never build their own nest to live; instead, they chase out other birds from their nest and occupy them. So, providing a low cost barn owl boxes will be



a substitute habitat for the owls to inhabit thereby increasing the predator population for rats in the field.

As the barn owl boxes are to be cost effective, it has been prepared from easily available sources like empty packaging boxes or woods from local trees. These boxes were placed about ten feet from the ground and tied on to the trees near the field. Barn owl boxes have been installed in six beneficiary villages – Agani, Nemmelli, Kondal, Ilayamadhukodam, Ilayankudi and Pagasalai. After installation, continuous monitoring was done to observe the barn owl incidence in the boxes using binoculars. All the nest boxes are inhabited by barn owls. This has proven that location and preference are important factors for attracting barn owl species to the fields.

Two different models were tried under the project

- Water proof plywood box and
- Wooden box (packaging material).

Water proof plywood barn owl box

Following the below mentioned measurements (17" and 15" height, 11" width and 19" bottom) the nest box was prepared. Iron base stand was fabricated and fixed at the bottom of the box and fixed with 10" – 15" long iron rod. To protect the box from strong sun light and rains the entire box was covered with thin iron sheet like an umbrella. Then the whole setup was erected by planting the iron rod.

Wooden (packaging material) barn owl box

This is very simple type of nest box. This packaging wood material is commonly available in villages and the cost of

the wood is also very low. The size of the nest box is – 18" high ; length – top – 38" and bottom – 26"; width - top – 12" and bottom – 21". After fabricating the nest box, it has been installed in 20 ft height in trees like tamarind, neem etc., facing the north or south side.

Details of the fabricators of barn owl boxes are as follows

1. Mr. P. Sattanathan, Nanthiyanallur Main Road, Kovilpathu Post, Sirkazhi taluk, Nagapattinam district. Mobile : 095859 47162
2. Prabha Engineering Works, Thennankudi main road, Kovilpathu post, Sirkazhi taluk, Nagapattinam district. Mobile : 099428 32675

The barn owl nest boxes were found useful in the following manner

- Barn owls are the major predators of rats and can be conserved using nest boxes and at the same time the rat menace is also controlled.
- An adult barn owl consumes up to 22 rats per day.
- The rodents are controlled effectively by this method and the yield loss is prevented.



- The nest boxes are very useful for the safe reproduction of the barn owls that in turn results in increased number of barn owls.

The feed back from the farmers were

- Farmers should erect barn owl boxes in their fields for the control of rats.
- Wooden boxes are most cost effective that can be used by the farmers for the conservation of barn owls.
- The cost spent towards the rat management in each season was significantly reduced by this method.

The expenses for fabricating barn owl boxes are as follows

1. Water proof plywood box

Plywood, screws, paint and other accessories	3,400
Labour	600
Umbrella (material and labour)	1,000
Iron rod 20 ft length	2,500
Bottom frame	600
Total	8,100

2. Wooden box (packaging material)

Wood	1,000
Labour	500
Iron sheet to protect the box from rain	500
Total	2,000

Chapter - 4

CONSERVATION OF SNAKE POPULATION

Snakes are yet another important predators of rodents. Snake population is also an important component for a balanced ecosystem. Rat menace can be handled effectively with the conservation of snakes. But there are so many misconception among people about the snakes. All snakes are considered poisonous and dangerous and the snakes are killed immediately once they are sighted. The hazardous chemical inputs applied for the crops for the management of pests and diseases also kills the snakes and reduce their population.

Conservation of Snakes

Under the programme on Ecofriendly rat management practices, conservation of snakes was also taken up to create awareness on importance of snakes among farmers and public. Many awareness campaigns were conducted for farmers, general public, and students etc., to educate them on the importance and use of snakes and their role in the stability of the ecosystem.

Snakes belong to the family Varanoidea. There are more than 200 types of snakes in Tamil Nadu, of which only four types of snakes are deadly venomous (Table 4).

Table 4 : Common Snakes of Tamil Nadu

Tamil	English	Remarks
<i>Nagapaambu</i>	King Cobra	Deadly venomous
<i>Saraipaambu</i>	Viper	Deadly venomous
<i>Kannadi virian</i>	Russell's viper	Deadly venomous
<i>Suruttaivirian</i>	Rat snake	Deadly venomous
<i>Komberi mookan</i>	Bronze back tree snake	Non – venomous and predate of rats
<i>Thaneervirian</i>	Water snake	Non – venomous and predate of rats
<i>Mannozhipaambu</i>	Sand wood viper	Non – venomous and predate of rats

Snakes use their venom only to immobilise their prey and kill them. Occasionally they use their venom for self-defence.

Snakes get in to the burrows of the rats and predate on the adults and young ones. So, the rat population reduced by them ultimately reduce the rat menace and yield loss. Each snake eat 3 – 4 rats per day. Snakes reduce up to 25% of the rat damage. Therefore, if a farmer spends Rs. 1,000 for rat management in a season snakes reduce it to Rs. 250 (25%) by predating on rats and inhibit the damage.

Awareness programmes were conducted for the farmers, general public, school teachers and students, women's group members etc., on "Rat Management by Conservation of Snake Population". Topics like importance of snakes, need to conserve them and rat management through snakes were dealt in detail. These

programmes were conducted with the help of resource persons from the Nilgiris Wild Life Conservation Centre. This Centre was established in 1877. Now the Centre has become an NGO and is involved in many conservation efforts in a tie up with Government. During the training programme, all these snakes were displayed to the participants. Participants came up with many doubts and all the doubts were cleared with elaborate explanations and demonstrations. The need for the conservation of snakes and how to identify the venomous snakes and non-venomous were explained.



Chapter - 5

RAT ERADICATION CAMPAIGNS

The rat eradication campaigns were conducted in the villages of Sirkazhi Taluk of Nagapattinam District. The main objective of this effort is to control rats in an integrated method. Rodents cannot be controlled by individual efforts of farmers like that of controlling pest and disease. Hence, the rat control activity will be completely successful only if it is done by all the farmers of an area. Otherwise, rats will migrate from one field to another. Based on this, rat control campaigns were taken up in Kondal, Nemmelli and Pagasalai Panchayats with the help of *Irulas*. In each village Panchayat three day long campaigns were conducted. As a part of these campaigns, training programmes on “Non-chemical Rat Management Techniques” were also conducted for the farmers. For the campaigns/awareness programme, all the necessary arrangements were taken care by the respective villagers and Panchayat Presidents. General public along with the targeted farmers participated in rat eradication campaigns. The details of the training programmes and eradication campaigns are provided in Table 5 and 6. The awareness programme included techniques for eco friendly rat management along with the following major topics.

- Types of rats
- Life cycle of rats
- Natural predators of rats
- Barn owls
- Rat control measures
- Harmful effects of chemical rodenticides.

Table 5 :
Details of the Awareness Programmes Conducted

Venue	No. of Participants
Government Higher Secondary School, Vaitheeshwarankovil	400 students
Aadhidraavidar Government Higher Secondary School, Kondal	210 students
CIKS Training Hall, Agani	21 individuals
CIKS Training Hall, Agani	62 persons
Best Matriculation Higher Secondary School, Sirkazhi	141 students
Good Samaritan Public School, Sirkazhi	136 students
CIKS training Hall, Allivilagam	32 women

Table 6 :
Details of the Rat Eradication Campaigns Conducted

Sl. No.	Name of the Panchayat	Eradication done for (days)	No. of farmers benefitted	Total area covered (Acre)	No. of rats caught
1.	Kondal	3 days	32	95.5	1,612
2.	Nemelli	3 days	56	78	1,661
3.	Pagasalai	3 days	35	99.5	876
Total			123	273	4,149

The results of the awareness programmes are summed up below.

- The rat damage was significantly reduced and controlled as the result of eradication campaigns.
- The concept of integrated rat management was accepted by all the farmers.
- Through these campaigns farmers gained knowledge on non-chemical rat management technologies, procedures and natural predators of rats.
- Farmers also learnt how ecofriendly management techniques conserves the birds, snakes and other living beings of the ecosystem to maintain the stability.
- They also realised the harmful effects of chemical rodenticides on environment, living beings etc.

The feedback received from the farmers are as follows,

- Rat eradication campaigns are very beneficial for the farming community.
- The yield loss due to rat damage was reduced since the rat control activity was taken up by integrated method.
- The rat management activity needs to be repeated in every crop season for effective control of rodents.
- Farmers are aware of the non-chemical rat management technologies and natural predators of the rats.
- They learnt the harmful effects of chemical rodenticides.
- These campaigns are very beneficial for all the farmers of the Panchayat.

Chapter - 6

CONCLUSION

Rat Management at Different Levels

Rodent population can be effectively managed by having a monitoring and control system in place. The following are some of the suggestions that would help in better management of rodents at different levels.

Farmers / Farming Community

- Should take the responsibility of collaborative rat control activity in their fields.
- All farmers should start the cultivation cycle at the same time and transplant at the same time. There should not be transplanting happening at different intervals in near by fields.
- Must follow only the organic techniques / ecofriendly methods of rat management.
- Should conserve the natural predators of rats like snakes, cats, barn owls etc.
- Each farmer should establish a nest box for the barn owls to live, breed and to predate on rats.
- The bunds around the fields should not be very broad. The narrow bunds will avoid the rats forming burrows.
- Bunds should be maintained clean without bushy weeds. This will reduce the rat menace.

Non-Government Organisations

- Should create awareness among farmers on ecofriendly rat management methods.

- Should take efforts to conserve natural predators of rodents.
- Should organise “ecofriendly rat eradication campaigns” in villages.
- Should conduct trainings on life cycle of rats and their control measures to the farmers.
- Should conduct awareness programmes on the importance of conservation of snakes, barn owls, owls etc.

Government Institutions

- Should stop the distribution of harmful chemical rodenticides for the rat management. Can train farmers on ecofriendly rat management methods.
- Should organise the rat eradication campaigns during cropping seasons.
- Should train farmers on integrated rat management practices.
- Should provide loans for the farmers for the purchase of traps and other management methods.
- Should distribute rat traps (cage type) at subsidised price to the farmers.
- The use of chemical rodenticides should be banned under the Wild Life Protection Act.

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Annexure-1

LIFE CYCLE OF RATS AND COMMON RAT MANAGEMENT PRACTICES FOLLOWED BY THE FARMERS

Though rats are well adapted to wild field conditions they can live in any kind of habitat, withstand stress and are prolific reproducers. They are also known as carriers of many disease causing bacteria and viruses. *Streptococcus pneumoniae*, *Corynebacterium kutscheri*, *Bacillus piliformis*, *Pasteurella pneumotropica*, and *Streptobacillus moniliformis* are some of the deadly bacterial parasites that live in the system of rats. The rat population in India is approximately 2500 million.

Normally rats are social creatures that live in colonies in dry places. They form burrows in the ground. The size of the colony is depends on the food supply available in the area. In Tamil Nadu four major types of rats are responsible for damage and loss at fields and storage godowns. These rats form burrows in fields and bunds around the fields.

- Indian Mole-rat (*Bandicota bengalensis*)
- Soft-furred Rat (*Millardia kondala*)
- Indian gerbil (*Tatera indica*)
- Little Indian Field Mouse (*Mus booduga*)

Apart from damage and loss at field and storage level, they also make the bunds weak by forming burrows thus result in loss of irrigation water through holes. Rats build their nests with various compartments like,

1. Food storage area
2. Nursery area – for ratlings
3. Resting area
4. Emergency exit part

Rats can consume about 10 – 15 g of food grains per day. Usually they reproduce thrice in a year. The life span of rats is 27 – 37 months. The reproduction capacity of the rat species in Tamil Nadu are as follows,

- Indian Mole-rat – 2 – 18 ratlings per reproduction cycle
- Soft-furred Rat – 1 – 12 ratlings per reproduction cycle
- Little Indian Field Mouse – 3 – 9 ratlings per reproduction cycle

Rats are very curious and sharp and nocturnal creatures. They can go around two kilometres in search of food. If a rat manages to withstand the rodenticidal poison and become normal it would not consume the same poisonous food again in its life span.

Common Rat Management Practices Followed by the Farmers

Thanjavur traps - Thanjavur traps are commonly used by the farmers of Tamil Nadu for the management of rats. These traps are very efficient in controlling rats in the fields. Since the working technology of this trap is very simple many farmers are using it several times in a single season. About 40 – 60 traps are used per acre. These traps are made from bamboo sticks and the making charge for a trap costs Rs. 30/-. Many farmers fabricate their own traps

since the technology is very simple. Farmers find this trap very comfortable and cost effective.

Perches for barn owls - Installation of T-shaped perches within the cultivated area provides the Barn Owl (*Tyto alba*) a vantage point to wait within the hunting area.. Small tree branches, sticks, pipes etc., erected in the fields helps barn owls to predate on rats. Rats are the major prey consumed by barn owls. An adult barn owl can consume around 22 rats per day. If they predate on more rats then they consume only heads of the rats and leave the body. An adult male, female and six chicks will consume 1200 – 1300 rats per month. Rats can be effectively managed if perches are erected in the fields. This is a very cost effective technique and does not require any technical assistance. Some farmers use old trunk of palm trees as perches. The same trunk also helps the barn owls to build their nests in the wide hollow space of the trunk when placed over the trees.

Fumigation method - The fumigation or smoke pot method of rat management is one of the traditional practices being followed by the farmers for a long time. In this method the rat burrows are identified and fumigated with thick smoke. The rats and ratlings that could not escape from the burrows get suffocated and die. Then the dead rats are removed from the burrows and discarded carefully. This method of rat management is actually being followed or implemented by *Irula* tribals. This management method is very effective since the colonies of rats are destroyed completely. Many farmers have learnt this technology from the *Irula* tribals and are implementing in their fields.

Annexure-2

ROLE OF IRULA'S EXPERTISE IN RAT MANAGEMENT EFFORTS

The Irulas are descendants from an ancient forest dwelling tribe of Southern India well known for their rat and snake catching skills as well as knowledge of local plants for treatment of snakebites and other diseases and disorders. These skills continued to be passed on from one generation to the other and the Irulas take pride in their traditional skills and knowledge.

They have traditionally lived off the forest as a wandering tribe collecting and selling minor forest produce like honey, bees wax etc. When situations become inhospitable, the Irulas migrated, usually as groups, to set up small colonies in areas that are generally avoided and excluded by mainstream society. A group of such migrants had settled down in a place called Sethiarthope (a small village between Chidambaram and Neyveli) and more recently, about 75-80 years ago, a small group of Irulas from Sethiarthope remigrated to Vaideeswaran Kovil and have been living there ever since, doing small menial jobs and/or working as agricultural labourers, construction labourers etc. As of now there are about 3 colonies (Savadithope, Nainarthope and Bhagat Singh Nagar) of Irulas totalling to about 40 families in the Vaideeswaran Kovil area.

Role of Irulas in the Rat Management

In an effort to reduce the use of chemicals and ensure sustainable management of the rat menace in agriculture, CIKS came up with the idea of utilising the services of the

Irula community. During the series of meetings and consultations with the Irula community, they expressed a keen interest and willingness to partner with CIKS and involve themselves in the project on the “Sustainable Management of Rats in Agricultural Systems”. An action plan was developed to use their traditional skills to catch and destroy the rats in the fields of a few selected farmers, to test and estimate the efficiency of the effort.

About 17 male members from the Irula community have come together to form the *Irula Adavar Suyu Udavi Kuzhu*, an all male Self Help Group (SHG). These 17 members meet every month to discuss work and other development issues that concern them. A monthly savings of Rs. 50/- is collected from each member, which is put into the savings account maintained by the SHG.

An assessment about predator population such as snakes, different species of snakes existing in the village, identification of species through the skin, pellets, etc., were done with help of experts from *Irula* community.

Collaborative efforts of Irulas and Farmer’s Clubs

CIKS works with several Farmer’s Groups in the Sirkazhi region and it was planned to take up rat control activities through these farmers’ groups in the beneficiary villages. The support of the Irulas was sought for identifying rat holes that were inhabited and destroying the entire colonies of rats using traditional methods. The program was designed so that the fields of all the members of a particular Farmer’s Club were treated simultaneously. A team of 3-4 members from the Irula SHG would visit a designated village and hunt out and kill all the rats from

the fields. This ensured that the rats did not escape from one field to another and it was also logistically more efficient. It was agreed that the farmer would pay each Irula man a sum of Rs. 300 for a day's work in addition to providing him lunch for the day. In highly infested fields the Irulas have sometimes even killed about 250-300 rats including males, females and young ones.

Rat management Technique followed by Irulas – An Explanation

The traditional method of fumigation or smoke pot method is followed by the Irulas for rat management in fields. A team would enter the designated field and identify all the holes that are inhabited by rats using their acute sense of hearing. Once the holes are identified they set about their work by systematically closing each exit point, smoke the rats to a specific hole and kill them by suffocation. The tools used for the activity include a small hand-held crowbar, an earthen pot, well dried hay and a spade. There are series of interconnected burrows through which the rats tend to escape when the smoke enters the burrows, so it is essential to sequentially seal off holes and prevent the rats from escaping. The Irulas are also aware about the breeding cycles of the rats and use this knowledge in the planning of their operations. It is evident that their method is very environment friendly and entire colonies are wiped out when this is done over a reasonably large area.

Under this project the rat management activities were taken up in large areas covering 10 villages. Farmers have noticed a substantial reduction in crop loss from fields that have been “treated” by the Irulas. They are satisfied with

the results and see the involvement of the Irulas as a positive step in the management of rat menace. This program serves multiple purpose, it supports the involvement of the local community in effectively managing an ecological issue and a social concern and is also helping to keep alive a traditional skill/ knowledge.

Benefits of the Programme

This program has benefited both the Irula community and the farming community equally. The Irulas are able to earn a decent income from their traditional skill while farmers are able to control rat populations without resorting to chemical use to control them. They are able to protect their lands and homes from being contaminated with dangerous chemicals. This method also seems to be more cost effective as the result of the “treatment” is valid for a longer period of time. The collaboration of Irula’s with the rat management activities of CIKS has improved the livelihood of farmers and Irulas in many ways like,

- Irulas have more opportunities for work
- Good relationship between farmers and Irulas
- Rats are controlled by ecofriendly and cost effective method.
- Indigenous knowledge is being conserved with efficient use in the fields.
- Environment is conserved without use of harmful chemical inputs.
- There is better cooperation and understanding among the community members
- Contribution of Irulas to society is being recognised and appreciated.

- Irulas have started thrift and saving schemes within the community
- There is an overall improvement in their economic level



Annexure-3

USE OF PLANT EXTRACTS FOR RAT MANAGEMENT

To overcome the ill effects of chemical rodenticides, there are some traditional methods mentioned in ancient literature and prevailing among farmers including use of plants as rodenticides. Three plant species such as *Gliricidia sepium*, *Glyceria grandis* and *Ipomea carnea* were selected and tested under laboratory at Department of Entomology, Faculty of Agriculture, Annamalai University, Chidambaram. This was done as a part of collaborative research with CIKS Sirkazhi.

Gliricidia sepium

Gliricidia sepium, often referred to as gliricidia, tree of iron and *seemai agathi* in Tamil. *Gliricidia sepium* is a medium-sized leguminous tree belonging to the family *Fabaceae* and can grow up to 12 meters height. The bark is smooth and its color ranges from whitish grey to deep red-brown. It has composite leaves measuring 30 cm long. Each leaf is composed of leaflets measuring 2 to 7 cm long and 1 to 3 cm wide.

The flowers are located at the end of branches. These flowers are bright pink to lilac colour tinged with white. A pale yellow spot is usually at the flower's base. The fruit is a pod measuring about 10 to 15 cm in length. Unripe fruit is green in colour and ripe fruit is yellow- brown in colour. The pod has 4 to 10 round seeds. The seeds are brown in colour. The tree is used in many tropical and sub-tropical countries for various purposes such as live fencing, fodder, coffee shade, firewood, green manure and rat poison.

Glyceria grandis

Glyceria grandis (Family: Poaceae) is a species of manna grass . It is most commonly found in wet areas such as riverbanks and ponds. This is a rhizomatous perennial grass bearing thin stems measuring two meters. The sturdy leaves have a prominent central vein. The tops of the stems is occupied with spreading, multi branched inflorescences bearing many small, oval-shaped spikelets.

Ipomea carnea

Ipomoea carnea, the pink morning glory, (Family: Convolvulaceae) is a species of morning glory. This flowering plant has heart-shaped green leaves measuring 6–9 inches long. It can be easily grown from seeds. The seeds are toxic and hazardous to cattle. It grows up to 5 metres. The stem is thick and develops into a solid trunk with many branches from base. The leaves are light green, heart shaped measuring 10-25cm long. Roots are boiled , extract used as laxative to provoke menstruation. The milky juice of the plant is used for the treatment of Leucoderma and other related skin diseases. Only external applications are recommended due to the poisonous nature of the plant. The plant is also of medicinal value. A glycosidic saponin has also been purified from *I. carnea* with anticarcinogenic and oxytoxic properties.

Preparation of extracts

***Gliricidia* bark extracts:** Fresh bark of *Gliricidia sepium* collected were chopped into small bits of 5cm length and ground in electric mixer. Then 25g, 50g, 100g, 150g, 200 g and 250 g were soaked in 1000ml of distilled water separately in conical flasks for 3 days to obtain 2.5, 5.0, 10.0, 15.0, 20.0, and 25.0 per cent concentrations

respectively. After 3 days the contents were filtered through muslin cloth and used.

***Glyceria grandis* whole plant extract:** Fresh plants of *Glyceria grandis* collected were chopped into small bits and ground in electric mixer. Then 25 g, 50 g, 100 g, 150 g, 200 g and 250 g were soaked in 1000ml of distilled water separately in conical flasks for 3 days to obtain 2.5, 5.0, 10.0, 15.0, 20.0, and 25.0 per cent concentrations respectively. After 3 days the contents were filtered through muslin cloth and used.

***Ipomea carnea* leaf extract:** Fresh leaves of *Ipomea carnea* collected were chopped into small bits and ground in electric mixer. Then 25 g, 50 g, 100 g, 150 g, 200 g and 250 g of leaf paste were soaked in 1000ml of distilled water separately in conical flasks for 3 days to obtain 2.5, 5.0, 10.0, 15.0, 20.0, and 25.0 per cent concentrations respectively. After 3 days the contents were filtered through muslin cloth and used.

Preparation of bait

500 g of cooked maize seeds were soaked in various concentrations of different extracts separately for 12 hours and then shade dried. This bait was used to feed rats.

Healthy female rats were starved overnight and were fed with Maize bait @ 50 g/ animal.

Observations: Animals were observed individually at least once during the first 30 minutes after feeding and periodically during the first 24 hours (with special attention given during the first 4 hours), and daily

thereafter, for a total of 14 days. Observations included changes in skin and fur, eyes and mucous membranes and behaviour pattern.

Result

In the Direct Oral administration method, *Gliricidia sepium* @ 25% concentration showed significant changes in locomotory activity and breathing of the treated animal. The colour of the skin was also dull and change in fur was observed.

This publication is a compilation of our experience and work carried out under the project on “Ecofriendly Management Strategies to Reduce Rat Damage in Agricultural Crops” implemented with the financial support from the Department of Science and Technology. It provides details on various experiments conducted on ecofriendly rat management practices, surveys conducted, rat management using Irula's expertise, rat management by conserving natural enemies like barn owls and snakes, rat eradication campaigns conducted in project villages and awareness programmes organized.



CIKS